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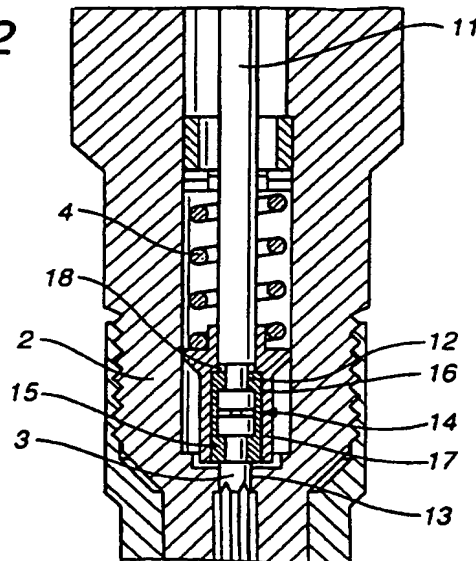
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(54) Coupling fuel injector nozzle needle and piston parts

(57) The rod 11 of a piston (7, Fig. 1) which effects needle lift when a solenoid valve (9) relieves the closing pressure on the piston is coupled to the nozzle needle 3 by a coupling including a sleeve 17. The coupling may comprise half shells 15, 16 retained engaging recesses in the ends of the parts 3, 11 by the sleeve 17 which is biased by the needle closing spring 17. The coupling may take other forms (Figs. 3 to 5).

Fig. 2

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Fig. 1

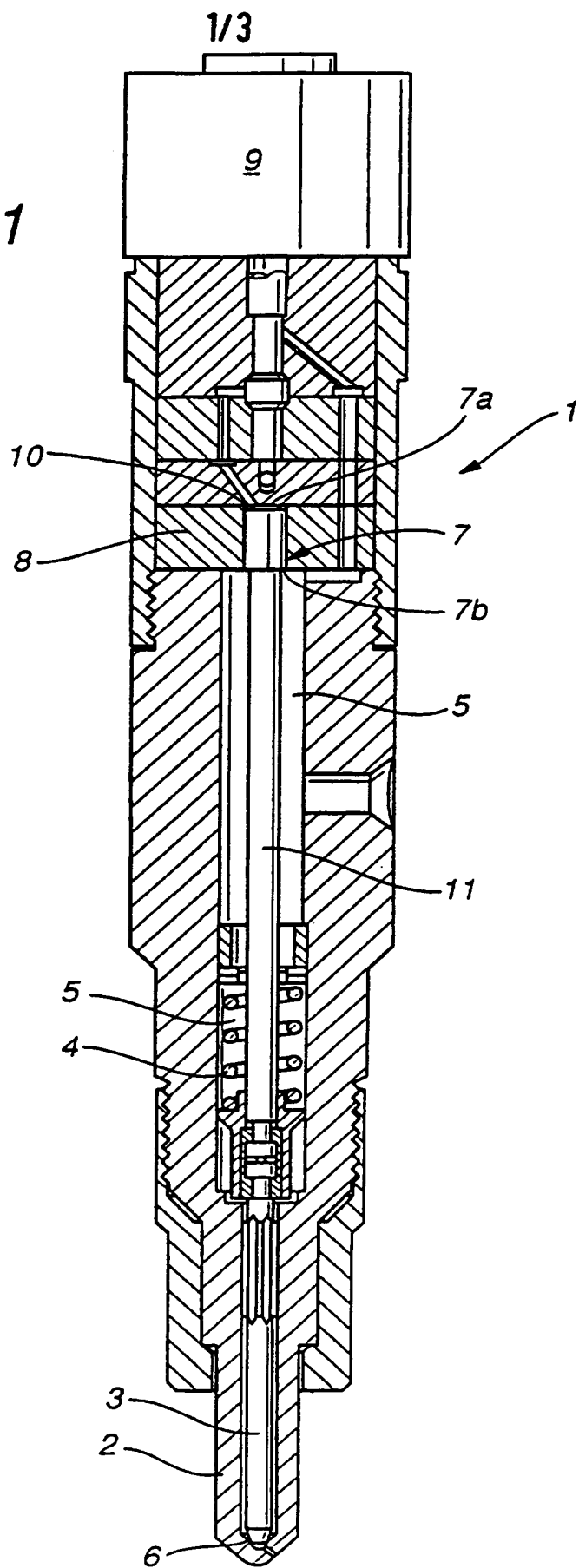


Fig. 2

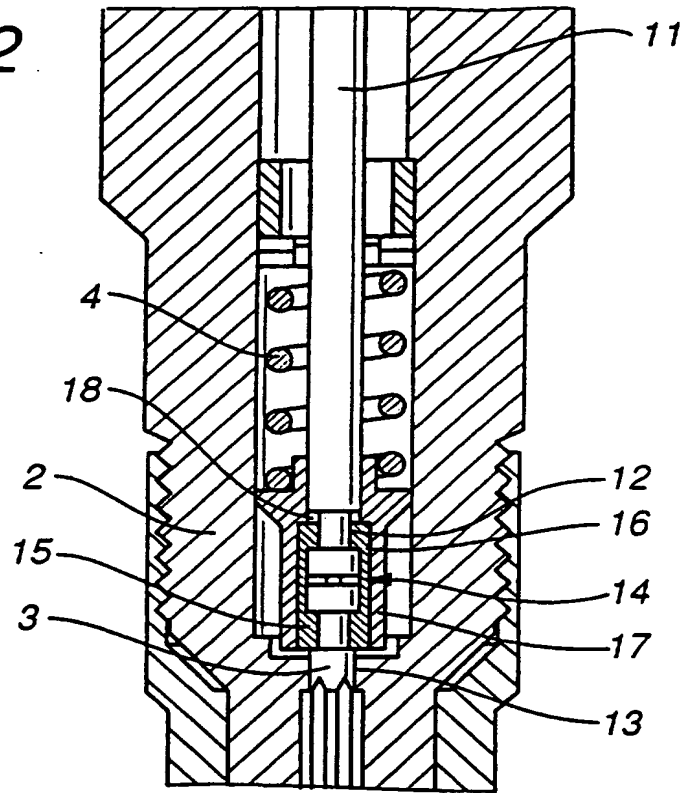


Fig. 3

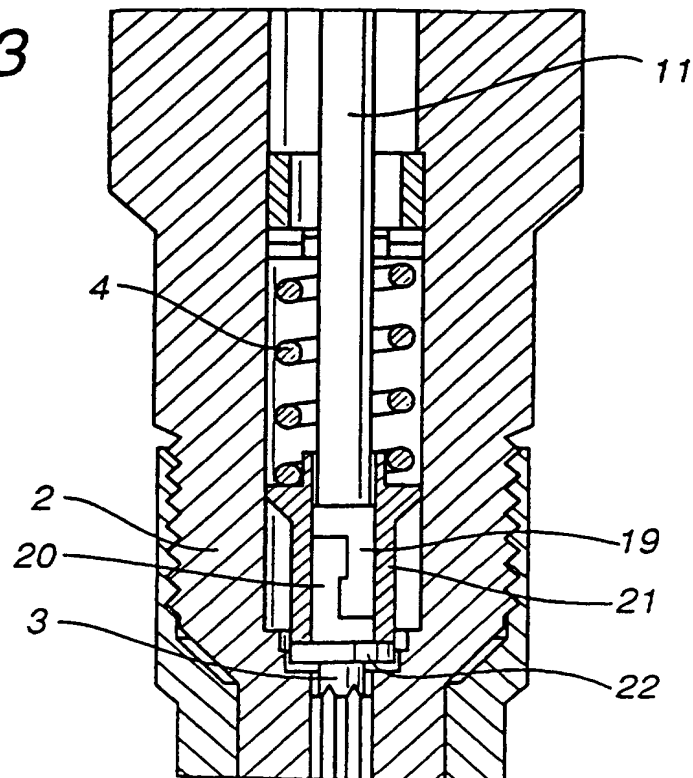
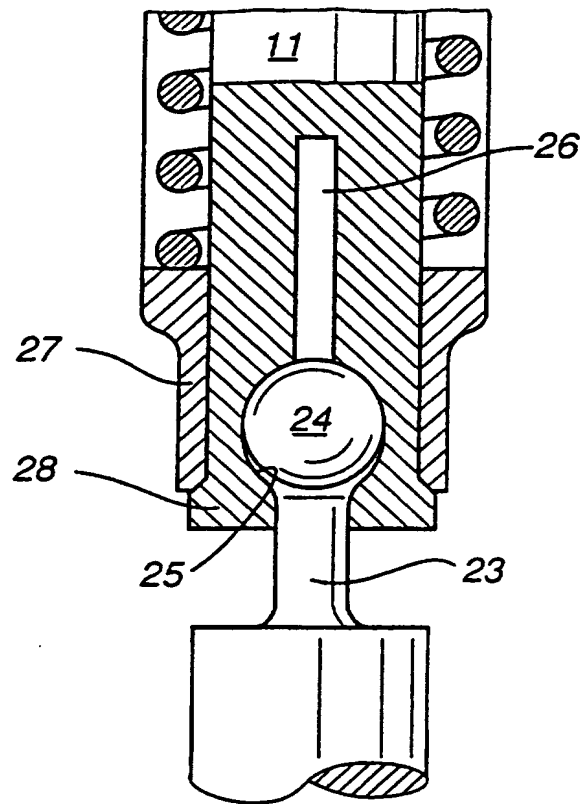
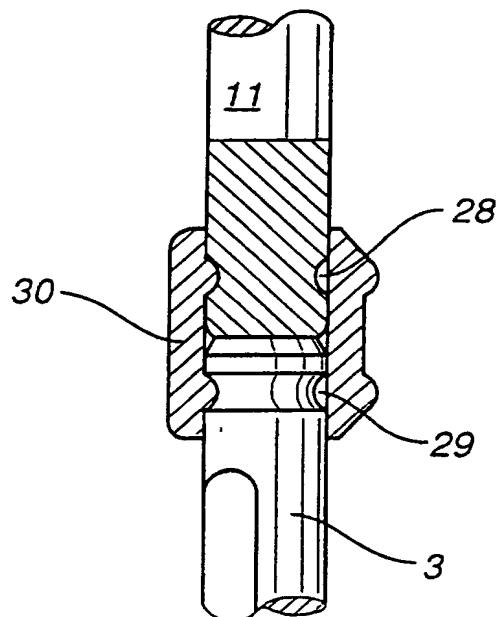


Fig. 4*Fig. 5*

Solenoid-valve-controlled injector
for direct fuel injection

The invention relates to a solenoid-valve-controlled injector for fuel injection into the combustion space of, preferably but not exclusively, a diesel internal combustion engine, with an elongate nozzle needle which rises from its valve seat counter to the direction of flow of the fuel and counter to the force of a return spring.

DE 32 27 742 C2 has disclosed a solenoid-valve-controlled injector with a nozzle needle pressed onto its valve seat by a return spring and with a piston which is acted upon on both sides by high pressure and delimits a large pressure reservoir in the spring space. The nozzle needle and the piston form a long component which is guided in various housing parts of the injector.

The present invention seeks to make the solenoid-valve-controlled injector disclosed in DE 32 27 742 C2 less sensitive to tolerances and less susceptible to wear as regards the guidance of the nozzle needle and the piston without prejudicing the favourable hydraulic behaviour provided by the large pressure reservoir in the spring space and the leakage-free sealing in the region of the nozzle.

According to the present invention there is provided a solenoid-valve-controlled injector for fuel injection into the combustion space of a diesel internal combustion engine, with an elongate nozzle needle which rises from its valve seat counter to the direction of flow of the fuel and counter to the force of a return spring and with a piston which interacts with the said nozzle needle, is acted upon on both sides by high pressure and the side of which facing the valve seat delimits a reservoir space containing the return spring and the side of which facing the solenoid valve delimits a control space which is connected to the reservoir space by a conduit or conduits and, for pressure relief at the solenoid valve, can be connected to a low-pressure line, wherein the elongate nozzle needle and the

piston form two separate parts which are connected positively to one another, at least in the closing direction of the nozzle needle, in the region of the piston-side end of the nozzle needle and in the region of the needle-side end of the stepped piston and are fixed in the radial direction by a union sleeve.

Advantageous further developments of the invention are given in the subclaims.

By virtue of the separation of the nozzle needle and the piston, the manufacture of the two components, which are of significantly shorter design, is unproblematic. By coupling the nozzle needle and the piston, a defined play at the connection point is furthermore possible, giving better guidance properties in the guides of the nozzle needle and the piston, i.e. a slight misalignment of the guides, which are provided in different housing parts, can be compensated for by the two-part nature of the reciprocating elements connected positively to one another.

The invention is depicted in the drawing and explained in greater detail below with reference to exemplary embodiments. In the drawing:

- Fig. 1 shows a solenoid-valve-controlled injector with a nozzle needle which is connected positively to a piston,
- Fig. 2 shows the connection point in an enlarged representation and
- Figs. 3-5 show different positive connections in enlarged representation.

A solenoid-valve-controlled injector 1 in accordance with Fig. 1 provided for diesel internal combustion engines comprises an elongate nozzle needle 3 which is guided in the nozzle body 2 and is pressed onto its valve seat 6 by a return spring 4 in the reservoir space 5, and further comprises a piston 7 of stepped design which is subjected to high pressure on both sides and is guided in a housing part 8 of the injector 1. Situated in the upper region of the injector 1 is the solenoid valve 9, via which the pressure

in a control space 10 subject to high pressure and bounded by the top side 7a of the piston 7 can be relieved. The underside 7b of the piston 7 is, like the top side, subject to a high pressure of the same magnitude, delimits the reservoir space 5 and, with its elongate piston rod 11, extends as far as the rear side of the nozzle needle.

The mutually facing end regions of the nozzle needle 3 and the piston rod 11 each have a recess 12, 13 into which a sleeve 14 split in the longitudinal direction engages positively with its half-shells 15, 16 (Fig. 2). A union sleeve 17 is placed over the two half-shells 15, 16, fixing the half-shells 15, 16 in the radial direction. The union sleeve 17, which simultaneously forms a spring plate for the return spring 4, has an inner collar 18 at the solenoid-valve end, this collar resting on the split sleeve 14.

Fig. 3 shows a connection point where the nozzle needle 3 and the piston rod 11 are provided with inter-engaging claw-like end pieces 19, 20 over which a one-piece union sleeve 21, which is simultaneously a spring plate for the return spring 4, is pushed and ensures a non-releasable connection between the nozzle needle 3 and the piston 7. The spring-loaded union sleeve 21 is supported on an outer collar 22 of the nozzle needle 3.

The positive connection in accordance with Fig. 4 is made up of a needle end portion 23 which is smaller in diameter than the nozzle needle 3 and has a larger, spherical head part 24 and a receiving hole 25, appropriately matched to this needle end portion 23, in the piston rod 11, the free end of the piston rod 11 being provided with a slot 26 which extends a long way beyond the receiving hole 25 and by means of which the end of the piston rod is splayed apart when the needle-end head part 24 is inserted into the receiving hole 25. Once the free end of the piston rod engages behind the head part 24 of the needle end portion 23, a sleeve 27 acting at the same time as a spring plate is pushed on to secure the positive connection, the said sleeve being supported on a widened portion 28 at

the end of the piston rod. The free end of the piston rod 11 can also be provided with an unstepped receiving hole 25 (not shown) and be crimped in behind the head part 24 of the end portion 23 at the needle end to establish the positive connection. Here, the slot 26 is dispensed with.

In Fig. 5, the end regions of the nozzle needle 3 and the piston rod 11 are each provided with an annular groove 28, 29 over which is pushed a sleeve 30 which has bead-like thickened portions (not shown) on its outside at the level of the annular grooves 28, 29. The sleeve 30 is pressed into union with the end regions of the nozzle needle 3 and the piston rod 11, the region of the bead-like thickened portions being pressed into the annular grooves 28, 29.

Claims

1. A solenoid-valve-controlled injector for fuel injection into the combustion space of a diesel internal combustion engine, with an elongate nozzle needle which rises from its valve seat counter to the direction of flow of the fuel and counter to the force of a return spring and with a piston which interacts with the said nozzle needle, is acted upon on both sides by high pressure and the side of which facing the valve seat delimits a reservoir space containing the return spring and the side of which facing the solenoid valve delimits a control space which is connected to the reservoir space by a conduit or conduits and, for pressure relief at the solenoid valve, can be connected to a low-pressure line, wherein the elongate nozzle needle and the piston form two separate parts which are connected positively to one another, at least in the closing direction of the nozzle needle, in the region of the piston-side end of the nozzle needle and in the region of the needle-side end of the stepped piston and are fixed in the radial direction by a union sleeve.

2. An injector according to Claim 1, wherein a recess is provided in the region of the mutually facing ends of the nozzle needle and the piston, and a two-part sleeve firmly surrounded by the union sleeve engages positively in the said recesses.

3. An injector according to Claim 2, wherein the union sleeve comprises a spring plate and has an inner collar which rests on the two-part sleeve.

4. An injector according to Claim 1, wherein the piston-side end of the nozzle needle and the needle-side end of the stepped piston are connected firmly, claw-fashion, in the axial direction and the interacting claws are locked by the union sleeve.

5. An injector according to Claim 4, wherein the nozzle needle has a collar adjoining the claws as a support for the union sleeve and the union sleeve comprises a spring plate.

6. An injector according to Claim 1, wherein that end portion of the nozzle needle which faces the piston is made smaller in diameter and is provided with a head part which rests in an appropriately adapted receiving part in the piston rod, the free end of the piston rod, which has a deep slot extending in the axial direction of the piston rod, engages behind the head part and is gripped by an encircling union sleeve which acts at the same time as a spring plate.

7. A solenoid-valve-controlled injector for fuel injection into the combustion space of a diesel internal combustion engine, substantially as described herein with reference to and as illustrated in the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)		Application number GB 9514898.7
Relevant Technical Fields (i) UK Cl (Ed.N) F1B, F2G GRX (ii) Int Cl (Ed.6) F02M 47/02, F16B 7/00, 7/04		Search Examiner R J DENNIS
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications.		Date of completion of Search 31 AUGUST 1995
(ii)		Documents considered relevant following a search in respect of Claims :- 1 TO 7

Categories of documents

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Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 1598577	(BOSCH)	1, 4 and 5
Y	GB 1101838	(CONTROLLED)	1 and 4
Y	GB 0733167	(FAIREY)	1, 4 and 5
Y	GB 0521736	(AMERY)	1, 4 and 5
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Y	EP 0385397 A2	(WEBER)	1, 4 and 5

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